Actomyosin in a low ionic strength solution containing L-histidine could not form heat-induced gel

Toru Hayakawa [1], Yu Kubono [1], Shuji Fujii [2], Jun-ichi Wakamatsu [1], Haruto Kumura [1]

[1] Research Faculty of Agriculture, Hokkaido University, [2] Department of Food and Life Science, Toyo University, Japan

Objectives: The heat-induced gelation of actomyosin plays a key role in meat processing. Our previous study showed that a low ion- ic strength solution containing L-histidine could affect the characteristics of a heat-induced gel of myosin. In the presence of L-his- tidine and at a relatively low temperature, myosin formed a transparent heat-induced gel. To determine the specific effect of L-his- tidine on protein aggregation in meat processing, that heat-induced gel properties of actomyosin in the presence of Lhistidine were investigated.

Materials and Methods: Actomyosin was prepared from fresh chicken breast muscle, and was dialysed against a solution of 1 mM KCl and 5 mM L-histidine. To induce gel formation, actomyosin solution (10 mg/ml) was heated in a test tube for 10 min in a wa- ter bath at 30-70°C, respectively. The turbidity of the actomyosin solution (1.0 mg/ml, heated at 30-70°C) was determined using the absorbance data at 370 nm. The dynamic viscoelasticity was measured to determine the storage modulus and the loss modulus of actomyosin (10 mg/ml, heated from 30°C to 70°C). Negative staining method for transmission electron microscopy observation was used with actomyosin solution (0.1 mg/ml, heated at 50°C and 70°C). The surface hydrophobicity of actomyosin solution (0.1 mg/ml, heated at 30-70°C) with 8 mM 8-anilino-1- naphthalenesulfonate magnesium was determined by fluorescence intensity measured at an excitation wavelength of 380 nm and at an emission wavelength of 475 nm.

Results and Discussion: Actomyosin in a low ionic strength solution containing L-histidine could not form a gel upon heating. The dynamic rheological properties of actomyosin in a low ionic strength solution that contained L-histidine were distinct from the properties of actomyosin in a solution that did not contain Lhistidine. The storage modulus of actomyosin in a low ionic strength condition with histidine was decreased at around 45°C degrees and increased gradually from 55°C. On the other hand, the storage and loss modulus of actomyosin in a high ionic strength solution increased at 45-50°C. These results suggested the morphology of actomyosin was affected on a low ionic strength condition with L-histidine. Therefore, the morphological and structural change of actomyosin during heating were investigated by electron microscopy and surface hydrophobicity. Electron microscopy showed that when actomyosin in a low ionic strength solution containing L-histidine was heated to 50°C, it remained a filamentous structure, while actomyosin in a low ionic strength solution aggregated and formed globular particles. This indicated that the aggregation of actomyosin depending on S-1 region of myosin could be inhibited by L-histidine. The surface hydrophobicity of actomyosin in a low ionic strength solution containing L-histidine was stable up to 50°C, while that of actomyosin in the absence of L-histidine in- creased after 40°C. This result suggested that structural change of actomyosin heated at 40-50°C would be suppressed by L-histi- dine.

Conclusions: L-histidine might have a considerable effect on suppression of the aggregation of actomyosin at 50°C, resulting in the inhibition of heat-induced gelation of actomyosin in a low ionic strength solution.

Key words: Actomyosin, Heat-induced gelation, L-histidine, Transmission Electron microscopy